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# Study on Vehicle-mounted Overloading Control System for Passenger Vehicles

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**Abstract**

For the problem of overloading passenger vehicles, vehicle-mounted overloading control system for passenger vehicles was designed. The system included sensor circuit, sensor control circuit and interface circuit with AT89C51 microcontroller. The software of the control system was designed in assembly language. Based on the actual number of passengers, starting of the vehicle was controlled by the control of the amount of fuel injection. Compared with the traditional control methods, the control system designed in this paper responsed quickly and saves a lot of manpower, material and financial resources. What's more, the number of the passengers in the vehicles can be real-time monitored to control overloading passenger vehicles better.



*Keywords:* Overloading control; Vehicle-mounted; Piezoelectric infrared sensors

## 1. Introduction

" People's Highway Law" clearly provides that vehicle overloading is illegal. Our country have also enacted a series of laws and regulations, local governments have also introduced a large number of files to control overloading of passenger vehicles, but the effect of any contingent is not obvious[1-2]. Practice has fully proved that the efforts that came only from policy to control overloading of passenger vehicles is not enough, which made the work of relevant departments seem rather passive. In recent years, automotive

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electronic control technology has been rapidly developed, and especially the control accuracy, control range, intelligence and networking, etc. have been greatly exceeded. In this paper, based on the platform of microcontroller AT89C51 microcontroller the passenger overloading control system was designed. Campared with the traditional control overloading methods, it can response fast, saved a lot of manpower, material and financial resources, and can be monitored in real time in the number of passenger, which can control better of overloading of passenger vehicles.

## 2. Composition and Working Principle of the Control System

In order to control overloading of the passenger vehicle, a automatic control system based on microcontroller for overloading passenger vehicle was designed in this paper. The system hardware is mainly composed of the sensor circuit, sensor working control circuit, fuel injection control circuit and other components. Sensor circuit mainly consists of the piezoelectric infrared sensor, photosensitive resistance, piezoelectric infrared signal processing chips and processing circuit. The sensor working control circuit is used to control the sensors by the opening and closing the door. The software of the system was compiled with the microcontroller AT89C51. The front-end detection system has two piezoelectric infrared sensors mounted on both sides of the door (one for the detection of persons getting on the bus, the other one for the off). The system started in time when the door opened. the piezoelectric infrared sensor may detect the infrared emissioned by the body, which had nothing to do with the dress, so the system is more reliable. When people gets on the bus, infrared sensors detect the number, ECU counts the number. when people gets off the bus, ECU subtraction the number. The rated passenger-capacity was stored in the ROM, when the passenger overloaded, the electronic control unit controlled the fuel injection system to stop fuel injection. So the vehicle could not start, which controlled the overloading[3]. The schematic structure diagram of overloading control system is shown in Fig.1.

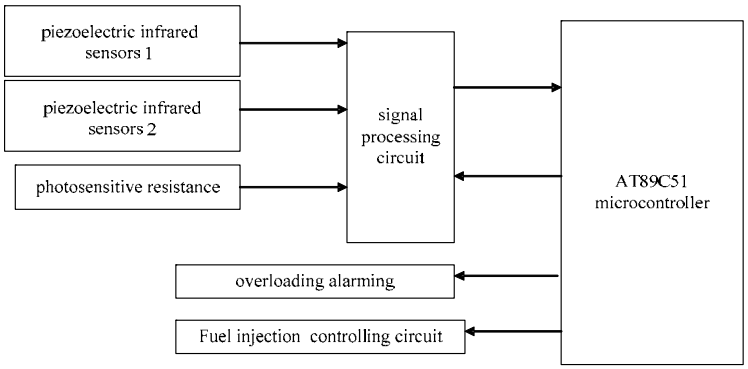


Fig. 1. Schematic structure diagram of overloading controlling system

### *2.1. Composition of the Sensor Circuit*

The sensor circuit in this article is composed of the piezoelectric infrared sensor, CDS photosensitive resistance and infrared pyroelectric processing chip. Piezoelectric infrared sensors on the body are selective to the sensitive objects, only the wavelength about of 10μm (human radiation infrared wavelength) infrared radiation sensitive , and nothing to do with how much clothing, so the objects except

the human body will not lead to probe action. Piezoelectric infrared sensor produces the charge, and the charge signal can't be directly used[4-5] .

Once the people get close, human infrared radiation focuse by part mirror,and received by pyroelectric element. But the two pyroelectric element received different heat, pyroelectric also different which can not be offset, so it has the test signal. When someone got on the bus, the infrared sensors detected, and the passenger number was accumulated and counted; when people got off, the microcontroller subtracted the count. Since the default number is set within the controller, when the counted passenger number is more than this number, the controller stopped fuel injection, which made the vehicle fail to start.

### *2.2. sensor control circuit and its working principle*

Sensor control circuit is shown in Fig.2. Sensors worked when the doors is open and close. When the door control circuit switch was closed, the door opened, and a certain terminal voltage (the voltage above 2.4 volts less than 5 volts)was ouput in 1 end. This pin is connected to P1.0 of AT89C51 microcontroller. The microcontroller determine whether to open the sensor circuit by detecting the signal of this pin. When the switch was opened, the door was closed, and the output voltage of the end 1 is low (generally less than 2.4 volts), two sensors is stopped to work by the microcontroller, which ensured that the sensor work when the door was open, and the sensors stopped working when the door closed.

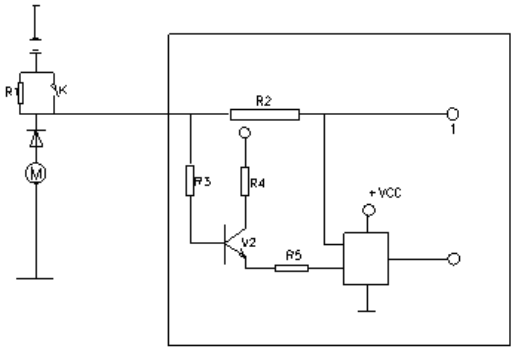


Fig.2 sensor controlled circuit

### *2.3. Control System Working principle*

working principle diagram of the control system is shown in Fig.3. As shown in figure 5, the sensors is controlled by P1.0. This pin was connectted with 1 end of the sensor control circuit. P1.2 and P1.3 were respectively the signal input end of the sensor 1 and sensor 2, respectively and They were connectted with 2 end and 3 end of the sensor operating circuit. P2.0 was connected to 4 end of the sensor working circuit. P2.1 controlled the fuel injection quantity. Two pyroelectric infrared sensors are used in this article. They were installed two different position to identify whether the passengers on or off.

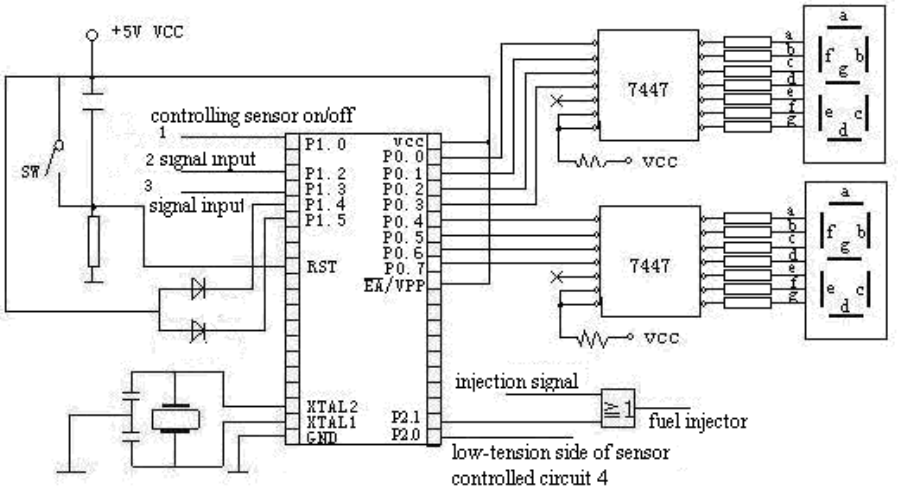


Fig. 3 control system working principle diagram

When the door switch was closed, P1.0 is received a high level signal. According to this signal, the P2.0 was determined whether was set as low or high level to control the sensors work. When the passengers was off the bus, firstly P1.3 pin was entered a low level signal, and then P1.2 pin was entered a low level signal, the counter is automatically decreased by 1. When the passengers got on the bus, P1.2 pin firstly was entered a low level signal, then P1.3 pin was entered a low level signal, then the counter was automatically increased by 1 end. At the same time, the number in the accumulatorr compared with the rated number of the passengers in the bus. If the number stored in the accumulator was greater than the rated number, pin P2.1 will be set as a low level. This signal and the fuel injection signal are through an AND gate, so that fuel injection signal will be in a low state, which made the fuel system stop working, aiming to controlling overloading.

## 3. System Software Design

The system software was designed in assembly language based on AT89C51 microcontroller. Its function is to determine whether a passenger was on the bus or off the bus according to the sequence of low signals received from the sensors of. When the passenger number in accumulator was more than rated number, the engine was controlled to stop fuel injection, so that the engine can not start. The main program flow chart of the system is shown in Fig.4, where, M was the actual number of passengers, N the rated passenger number.

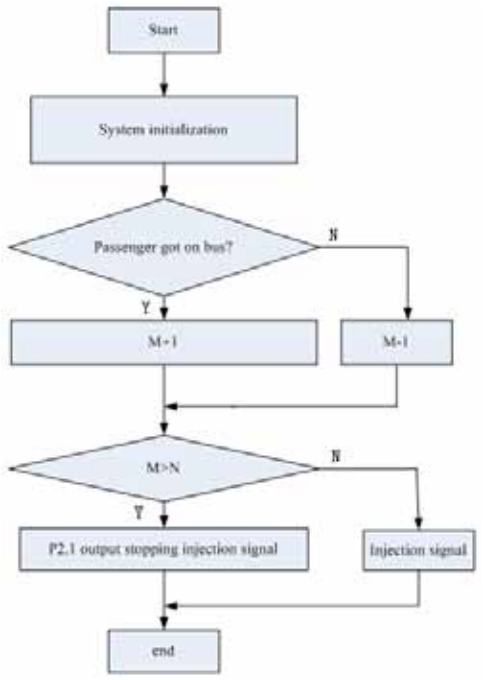


Fig.4 main program flow chart of the system

## 4. Conclusion

The passenger vehicle-mounted overloading control system based on AT89C51 microcontroller was designed in this paper. It responsed fast , and it can well meet the requirements of passenger counting circuit. The system was also very convenient to install. Compared with the traditional control methods, the control system designed in this paper responsed quickly and it can savea lot of manpower, material and financial resources. What's more, the number of the passengers in the vehicles can be real-time monitored to control overloading passenger vehicles better.

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